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Injectable Microengineered Tissues for Cardiac Regeneration

Each year, millions of patients, globally, suffer from heart failure and cardiovascular disease. Stem cell transplantation and tissue engineering strategies have tremendous potential for repair and/or regeneration of injured myocardium. The major hurdles in stem cell transplantation are poor cell survival, insufficient cardiogenic differentiation, and the lack of suitable biomaterials to provide a 3D microenvironment with sufficient cues for cellular assembly. Tissue engineering strategies suffer from inadequate vascularization and the need for surgically invasive procedures to implant the constructs. With a shortage of donors and high risks of transplantation, new therapeutic strategies are needed to meet this critical health demand. Researchers at Arizona State University have developed an innovative and multidisciplinary approach, based on microengineering technology, advanced biomaterials and human pluripotent stem cells, to develop injectable microscale tissues for functional therapeutic cardiac regeneration. They have developed a new class of biomaterials with specifically tuned properties for use as a novel injectable, in situ forming and cross-linking cardiac cell embedded hydrogel. The unique features of these materials allows for support of cardiac and vascular cell functions within a 3D microenvironment.

This technology bridges the gap between stem cell based transplantation and tissue engineering strategies while requiring minimally invasive procedures to address current limitations in cardiac repair and regeneration.

Potential Applications

- Therapeutic regeneration of injured myocardium

Benefits and Advantages

- Generation of pure populations of ventricular-specific cardiac progenitor cells
- Well-designed organization to regain robust cellular connections upon transplantation
- Enhanced cell survival and engraftment with promotion integration of microengineered tissues with the injured myocardium
- Promotes formation of microcapillaries within the 3D microenvironment of

the hydrogel

- Minimally invasive - the materials can be delivered via catheter within the infarcted zone of myocardium
- The materials are injectable and undergo a physical gel transition then curing to create a matrix resistant to creep
- The materials can be functionalized to promote formation of microcapillaries

For more information about the inventor(s) and their research, please see Dr. Nikkhah's laboratory webpage